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THE FORMATION OF ANTIPODAL-IMPACT TERRAINS ON MARS;

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The regions antipodal to Mars' three largest impact basins, Hellas, Isidis, and Argyre, were assessed for evidence of impact-induced seismically-disrupted terrains. Photogeology and preliminary computer modeling using the Simplified Arbitrary Lagrangian-Eulerian computer program (Watts et al., 1989) [1] suggest such terrains could have been formed by the Hellas and Isidis impacts. Maximum antipodal pressures are 1.1×10^9 Pascals for Hellas, 5.2×10^8 Pascals for Isidis, and 1.5×10^8 Pascals for Argyre.

Previously, the only assessment of potential surface disruptions on Mars antipodal to large impacts was by Peterson (1978) [2]. He described the terrain at the antipodes of Hellas, Isidis, and Argyre impact basins, and suggested that focusing of seismic shocks from the Hellas impact might have produced the volcanic conduit at Alba Patera through which magma could reach the surface. He also suggested that older fractures in Noctis Labyrinthus may have been generated or modified by the Isidis impact.

Our results give credence to Peterson's assertions. For Hellas, the computer model clearly suggests that antipodal pressures were probably strong enough to have fractured the crust and disrupted the surface, and may account for aspects of volcanism at Alba Patera. Alba Patera has long been recognized as unusual (or perhaps unique) in the solar system (Carr et al., 1977a) [3]. It is a "central vent" volcano containing a caldera complex about 100 km across and has flows that can be traced radially more than 1000 km, making it the largest such volcano seen anywhere. The long flows indicate high rates of effusion (Greeley and Spudis, 1981) [4] which ordinarily are associated with flood eruptions from fissures. For example, long flows seen on the Moon are inferred to have been derived from fissures associated with basin-related fractures (Schaber, 1973) [5]. In contrast, the Alba Patera flows appear as narrow sheets and tube-fed flows erupted from vents of limited extent. This would suggest that the magma supply and conduit system is centrally-located and different from that of the Moon. Moreover, the low flank slopes of Alba Patera may indicate a different style of volcanism than that of the other Tharsis volcanoes on Mars, all of which are high-standing edifices.

We suggest that the Hellas impact produced sufficient focused energy at its antipode to produce deep fractures in the Martian crust centered below the current caldera for Alba Patera. With the generation and evolution of magma in the Tharsis area, the fracture system provided a ready conduit for early-stage eruptions of Martian lavas derived from deep in the crust/upper mantle, perhaps of komatiitic composition (Burns ans Fisher, 1989) [6]. These fluid lavas were erupted at high rates from the central zone of the antipodal fractures and spread to great distance to form the basal lavas of Alba Patera. This occurred in the Hesperian, long after Hellas disrupted the antipodal interior. The change in morphology.

to tube-fed flows at Alba Patera for the later deposits suggests lower rates of effusion of a sporadic character (Greeley and Spudis, 1981) [4], which may reflect lower rates of magma production, more constrained conduits, more "evolved" magmas, or some combination of these factors.

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The computer model gives antipodal pressures for the Isidis impact very close to those produced by the Imbrium impact on the Moon and by the Caloris impact on Mercury, suggesting that disrupted terrains should have been produced. Although none are seen, Peterson (1978) [2] suggested that some of the fractures of the Noctis Labyrinthus system may have been generated or influenced by the Isidis impact. Some of the fractures in the Noctis Labyrinthus system are radial to or concentric about the Isidis antipode. Carr (1974) [7] suggested this topographically high region might be due to crustal upwarping caused by mantle convection in Tharsis. The load from Tharsis volcanics may have reactivated certain aligned older fractures, previously emplaced by Isidis antipodal activity (Peterson, 1978) [2]. Thus, Noctis Labyrinthus may be a younger feature that owes its location at least partly to the antipodal effects of a major impact. The lack of visible features at the Argyre antipode suggests that either the low antipodal pressures were insufficient to disrupt the terrain, or such terrain was produced but has since been obliterated.

References: [1] Watts, A.W., R. Greeley, and H.J. Melosh, 1989, Lunar and Planetary Science XX, pp. 1183-84.; [2] Peterson, J., 1978, Lunar and Planetary Science IX, pp. 885-6.; [3] Carr, M.H., K.R. Blasius, R. Greeley, J.E. Guest, and H. Masursky, J. Geophys. Res., 82, pp. 3985-4015, 1977a.; [4] Greeley, R. and P.D. Spudis, Reviews of Geophysics & Space Physics, 19, #1, pp. 13-41, Feb., 1981.; [5] Schaber, G.G., Proc. 4th Lunar Sci. Conf., pp. 73-92, 1973.; [6] Burns, R.G. and D.S. Fisher, LPI Tech. Report 89-04, pp. 20-22, LPI, Houston, Texas, 1989.; [7] Carr, M.H., J. Geophys. Res., 79, # 26, pp. 3943-3949, 1974.